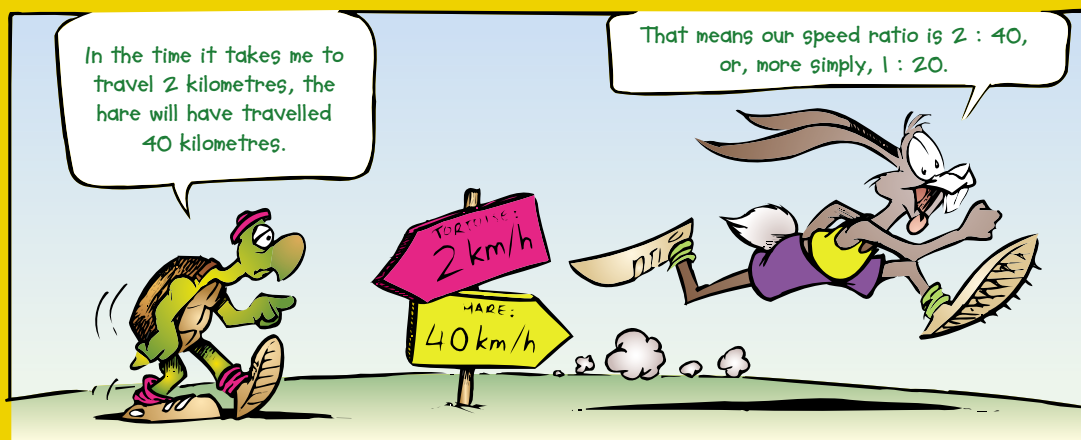


Ratio, Rates and Scale Drawing



Chapter Contents

11:01	Ratio	NS4:3	11:05	Rates	NS4:3
11:02	Equivalent ratios	NS4:3	11:06	Scale drawing	NS4:3, SGS4:4
	Challenge: How are you at mixing paint?			Investigation: Scale my room!	
11:03	Using ratio to solve problems	NS4:3		Challenge: Cutting rectangles	
	Investigation: Using ratio			Fun Spot: What do you call a deer with no eyes?	
11:04	Dividing a quantity in a given ratio	NS4:3		Maths Terms, Diagnostic Test, Revision Assignment, Working Mathematically	
	Fun Spot: Multiplication can be fun				
	Investigation: Ratio search				

Learning Outcomes

NS4:3 Operates with fractions, decimals, percentages, ratios and rates

Working Mathematically Stage 4

1 Questioning, 2 Applying Strategies, 3 Communicating, 4 Reasoning, 5 Reflecting

Examples of ratio are found in many real-life situations. One such situation occurs when you have to add water to a juice concentrate to make up a fruit drink.



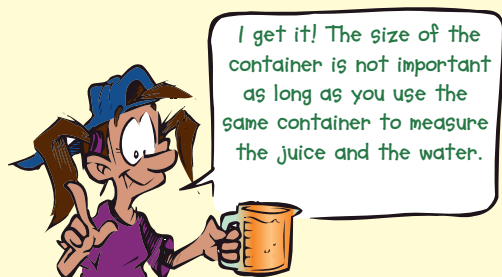
The instructions on this juice packet say:
'Mix 1 part juice with 3 parts water'.

This example illustrates many of the important aspects of ratio.

- First, a ratio is a comparison of two like quantities. In this example we are comparing the **volume** of juice that needs to be mixed with the **volume** of water.
The relative sizes of the numbers give the correct sweetness to the drink. Varying the numbers in the ratio will give either a sweeter drink or a watered-down drink.
- Second, the order of the numbers in the comparison is important. If the instructions read '3 parts juice with 1 part water', this would not be the same as '1 part juice with 3 parts water'.
- Notice that there is no mention of units. The word 'parts' is used to indicate that whatever units are used to measure the juice must also be used to measure the water. The size of the unit or measure is not important.

So:

- 1 litre of juice would need 3 litres of water, *or*
- 500 millilitres of juice would need 3×500 millilitres of water, *or*
- 100 millilitres of juice would need 3×100 millilitres of water, and so on.



To write this ratio down we could write:

- ratio of juice to water = 1 : 3, *or*
- ratio of water to juice = 3 : 1.

Alternatively we could write it in fraction form:

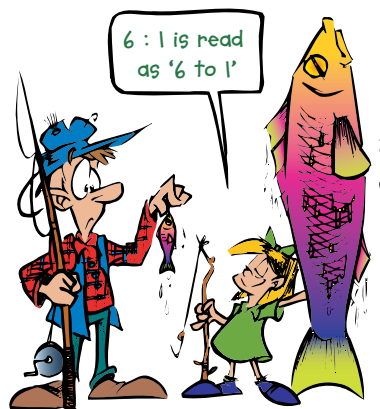
- ratio of juice to water = $\frac{1}{3}$, *or*
- ratio of water to juice = $\frac{3}{1}$

1 bucket of juice would need 3×1 buckets of water.

A **ratio** is a comparison of numbers in a definite order. The numbers are expressed in the same units and are called the **terms** of the ratio. The ratio can be written in the form $a : b$ or $\frac{a}{b}$ or a to b .

worked examples

- 1 Jill says to Jack: 'My fish is six times as long as your fish'. Jill is comparing the length of her fish to the length of Jack's fish.
 - a Write down the ratio of:
 - i the length of Jill's fish to the length of Jack's fish
 - ii the length of Jack's fish to the length of Jill's fish.
 - b Does Jill's statement tell us the actual length of either fish?



Solution

- a If Jack's fish is 1 unit long, then Jill's fish is 6 units long. So the ratio of:
 - i the length of Jill's fish to the length of Jack's fish = $6 : 1$
 - ii the length of Jack's fish to the length of Jill's fish = $1 : 6$.
 - b Jill's statement does not tell us anything about the actual lengths of the two fish. All it says is that whatever the length of Jack's fish, her fish is six times longer. If we know the length of either fish we could work out the length of the other.
- 2 Bronte buys a guinea pig for \$2 and later sells it for \$3. Find the ratio of her:

a selling price to cost price	b selling price to profit
c cost price to profit	d cost price to profit to selling price

Solution

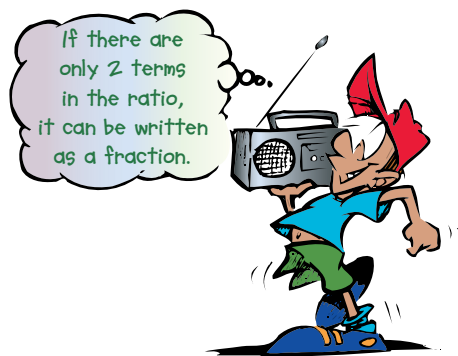
Now, selling price = cost price + profit.

$$\therefore \text{cost price} = \$2$$

$$\text{profit} = \$1$$

$$\text{selling price} = \$3$$

- a selling price : cost price = $3 : 2$ or $\frac{3}{2}$
- b selling price : profit = $3 : 1$ or $\frac{3}{1}$
- c cost price : profit = $2 : 1$ or $\frac{2}{1}$
- d cost price : profit : selling price = $2 : 1 : 3$



We can use ratios to compare more than 2 numbers.
eg I earned \$A in week 1, \$B in week 2 and \$C in week 3.
Ratio of earnings of week 1 : week 2 : week 3 = A : B : C

Exercise 11:01

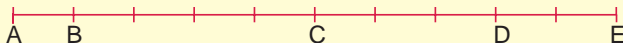
- 1** Liam says that he has four times as much money as Bronwyn.
- a** What is the ratio of:
 - i** Liam's amount of money to Bronwyn's amount of money?
 - ii** Bronwyn's amount of money to Liam's amount of money?
 - b** Do we know the amount of money that Liam or Bronwyn actually has?
- 2** 'I can lift twice as much as you', says Milla to Dominic.
- a** Do we actually know how much either person can lift?
 - b** What is the ratio of:
 - i** the amount that Milla can lift to the amount that Dominic can lift?
 - ii** the amount that Dominic can lift to the amount that Milla can lift?
- 3** The ratio of cement to sand in a mortar mix is 1 : 4 (1 part cement to 4 parts sand).
- a** What fraction of the mortar is cement?
 - b** What fraction of the mortar is sand?
- 4** A particular paint colour, 'Sunset', is made by mixing red and yellow paints.
- a** If $\frac{3}{5}$ of 'Sunset' is red, what fraction of 'Sunset' is yellow?
 - b** What is the ratio of red paint to yellow paint in 'Sunset'?
- 5** Kylie buys chickens for \$3 and sells them for \$5. Find the ratio of:
- a** selling price to cost price
 - b** selling price to profit
 - c** cost price to profit
 - d** profit to selling price
 - e** cost price to profit to selling price.
- 6** A class contains 14 boys and 16 girls.
- a** What is the ratio of boys to girls?
 - b** What is the ratio of girls to boys?
 - c** What is the ratio of boys to the total number of students in the class?
 - d** What fraction of the class is boys?
 - e** What is the ratio of girls to the total number of students in the class?
 - f** What fraction of the class is girls?
- 7** A breeder of budgerigars notes that the colours of birds born are in the ratio yellow : blue : other colours = 5 : 3 : 2.
- a** What colour is the most common?
 - b** What colour is the least common?
 - c** What fraction of the birds is yellow?
 - d** What fraction of the birds is blue?
 - e** What is the ratio of blue birds to the total number of birds?
- 8** Concrete is made by mixing cement, sand and gravel in the ratio 1 : 2 : 4.
- a** What fraction of concrete is cement?
 - b** What fraction of concrete is gravel?
 - c** What is the ratio of cement to gravel?
 - d** What is the ratio of sand to gravel?
 - e** If we use 1 kg of cement, how much gravel should we use?



■ Ratios can have more than two terms.

- 9** What is the ratio of:
- a** a centimetre to a millimetre?
 - b** a metre to a centimetre?
 - c** a kilogram to a gram?
 - d** a litre to a millilitre?
 - e** a minute to a second?

- 10** The line below is divided into ten equal parts.



Find the ratios:

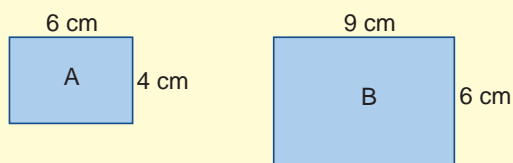
- a** $\frac{AB}{AE}$
- b** $\frac{AB}{BC}$
- c** $\frac{AE}{AB}$
- d** $\frac{CD}{CB}$
- e** $\frac{CD}{AE}$

- 11** One-third of a class is girls.

- a** What fraction of the class is boys?
- b** What is the ratio of boys to girls?
- c** What is the ratio of girls to boys?

- 12** What is the ratio of:

- a** length of rectangle A to length of rectangle B?
- b** width of rectangle A to width of rectangle B?
- c** area of rectangle A to area of rectangle B?



- 13** The correct sweetness for a drink is obtained by mixing cordial and water in the ratio of 1 : 3.

- a** If the ratio of cordial to water were 1 : 4, would the drink be sweeter than if it were mixed properly?
- b** Bill mixes water and cordial in the ratio 2 : 1. Would his drink be sweeter or watered down compared to the proper mixture?



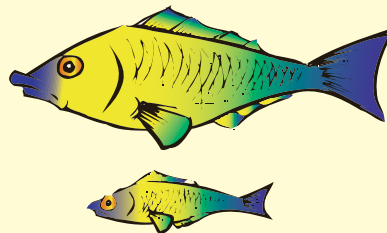
- 14** **a** A pink-coloured paint is made by mixing red and white in the ratio of 1 : 5. If the red and white paints were mixed in the ratio 1 : 8, would the paint be lighter or darker than the original?
- b** Cement mortar is made by mixing sand and cement in the ratio 5 : 2. Stronger mortar is made by increasing the fraction of cement in the mixture. If the ratio of sand to cement in a mix were 7 : 2, would this be stronger or weaker than the mix mentioned above?



In comparing two quantities we often do not know the actual size of either. For example, the statement 'My fish is twice as long as yours' only gives us the **relative** sizes of the two fish. There are an infinite number of actual ratios that could describe this situation, such as:

a 16 cm : 8 cm **b** 10 cm : 5 cm **c** 1 m : $\frac{1}{2}$ m

In all of these, the first term is twice the second term, and the simplest ratio to express this relationship is 2 : 1. In this way the set of ratios behaves like the set of equivalent fractions, $\frac{16}{8}$, $\frac{10}{5}$, etc, so we can simplify ratios in the same way that we simplify fractions.



If the terms of a ratio are multiplied or divided by any number (except zero), an **equivalent ratio** is formed.

worked examples

1 Are the ratios 3 : 1 and 12 : 10 equivalent?

2 Simplify these ratios:

a 15 : 12

b 3.5 : 1.5

c $3 : \frac{1}{2}$

d $2\frac{1}{3} : 1$

e 1 m : 20 cm

3 A school has 650 girls and 500 boys. What is the ratio of boys to girls?

Simplifying ratios is just like simplifying fractions.



Solutions

1 $3 : 1 = \frac{3}{1}$ and $12 : 10 = \frac{12}{10}$
 $\frac{3}{1} = \frac{3 \times 4}{1 \times 4} = \frac{12}{4}$ not $\frac{12}{10}$

\therefore 3 : 1 and 12 : 10 are not equivalent.

2 a 15 : 12 or 15 : 12
 $= \frac{15}{3} : \frac{12}{3}$
 $= 5 : 4$
 $= \frac{15}{12}$
 $= \frac{5}{4}$
 $= 5 : 4$

b 3.5 : 1.5
 $= \frac{3.5 (\times 10)}{1.5 (\times 10)}$
 $= \frac{35 (\div 5)}{15 (\div 5)}$
 $= \frac{7}{3}$
 $= 7 : 3$

c $3 : \frac{1}{2}$
 $= 3 \times 2 : \frac{1}{2} \times 2$
 $= 6 : 1$

d $2\frac{1}{3} : 1$
 $= \frac{7}{3} : \frac{3}{3}$
 $= 7 : 3$

e 1 m : 20 cm
 (Change to the same units.)
 $= 100 \text{ cm} : 20 \text{ cm}$
 $= \frac{100}{20} : \frac{20}{20}$
 $= 5 : 1$

3 boys : girls = 500 : 650
 $= \frac{500}{50} : \frac{650}{50}$
 $= 10 : 13$

Exercise 11:02

1 Copy and complete the following.

a $2:1 = 6:\square$

b $15:1 = 30:\square$

c $1:4 = 20:\square$

d $2:3 = 6:\square$

e $9:5 = \square:15$

f $3:13 = \square:52$

g $3:4 = \square:12$

h $6:5 = \square:20$

i $6:4 = 3:\square$

j $9:3 = 3:\square$

k $12:8 = 3:\square$

l $20:6 = 10:\square$

m $10:15 = \square:3$

n $24:36 = \square:3$

o $48:100 = \square:20$

p $35:120 = \square:24$

2 Simplify the following ratios.

a 15:5

b 10:30

c 24:16

d 16:30

e 25:75

f 120:8

g 100:10

h 100:1000

i 66:11

j 12:72

k 8:20

l 320:48

m 8:96

n 14:49

o 30:42

p 15:200

q 27:18

r 40:72

s $\frac{5}{15}$

t $\frac{20}{5}$

u $\frac{16}{40}$

v $\frac{100}{45}$

w $\frac{24}{36}$

x $\frac{42}{12}$

3 Simplify the following ratios after first changing to the same units.

a 3 cm : 1 mm

b 5 cm : 20 mm

c 1 m : 50 cm

d 25 m : 1 km

e 1.5 km : 200 m

f 3.5 L : 500 mL

g $1\frac{1}{2}$ h : 30 min

h 200 kg : 1 t

i $1\frac{1}{4}$ min : 15 s

j 2 days : 6 h

k \$5 : 50c : \$5.50

4 Simplify the following ratios.

a 1:2:1

b 3:6:1:2

c 4:5:6

d 6:25:1

e 1:2:6

f $\frac{1}{2} : \frac{1}{10}$

g $\frac{1}{10} : \frac{1}{5}$

h $\frac{2}{3} : 1$

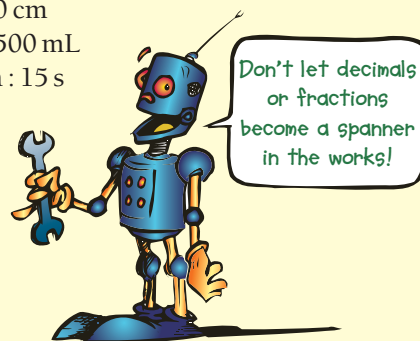
i $1 : \frac{3}{4}$

j 20:70:50

k 8:4:12

l 33:9:12

m 100:65:35



5 **a** In 8M there are 16 boys and 14 girls. What is the ratio of:

i boys to girls?

ii girls to boys?

iii boys to the total number in the class?

iv boys to girls to the total number in the class?

b If a woman sells a pot for \$60, thereby making a profit of \$20, find the ratio of:

i profit : cost price

ii selling price : cost price

iii profit : selling price

iv cost : profit : selling price

c On a scale drawing 1 cm represents 1 m. Write this as a ratio.

d A store has a discount sale. A suit marked at \$250 is sold for \$200.

i What is the ratio of the discount to the marked price?

ii What is the ratio of the marked price to the discount to the selling price?

e Two business partners, Carol and Sharon, invest \$4500 and \$2500 each in a business. What is the ratio of Carol's share to Sharon's share?

f In an election, Bagnell scored 225 votes, Farrant 175 votes and McGregor 125 votes. Find the ratio of: Bagnell's votes : Farrant's votes : McGregor's votes. (Express this ratio in its simplest form.)

■ A discount is a reduction in price.

g An alloy is made by combining 2.5 kg of metal A with 1.5 kg of metal B and 2 kg of metal C. Find the ratio of the weights of:

- i** metal A to metal B **ii** metal B to metal C
iii metal A to metal C **iv** metal A to the alloy
v metal A to metal B to metal C.

h On a map, a distance of 1.5 cm represents 5 km. What is the ratio of the distance on the map to the real distance?

Note:
 $2.5 : 1.5 : 2$
 (Multiply by 10)
 $= 25 : 15 : 20$

6 Express each of the following ratios in the form of $a : 1$ by dividing both terms by the second term, eg $7 : 5 = \frac{7}{5} : \frac{5}{5} = 1.4 : 1$.

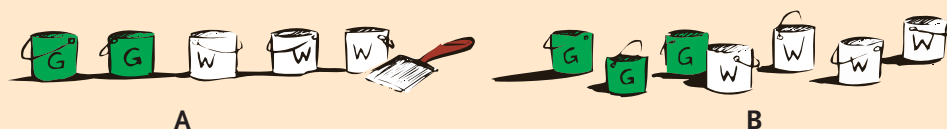
- a** 16 : 5 **b** 12 : 8 **c** 9 : 12 **d** 1.6 : 1.2 **e** 0.2 : 0.8

7 Express each of the following ratios in the form $1 : b$ by dividing both terms by the first term, eg $6 : 8 = \frac{6}{6} : \frac{8}{6} = 1 : 1\frac{1}{3}$.

- a** 20 : 12 **b** 16 : 8 **c** 8 : 15 **d** 1.5 : 6 **e** 2.4 : 8.4

Challenge 11:02 | How are you at mixing paint?

When green paint is mixed with white paint you get a light green colour. The more white you use, the lighter green you get.

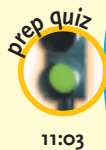


- If the paints in each picture were mixed, which mixture would give the darker green? Give a reason for your choice.
- Which of the reasons below are correct?
 - a** Batch **B** is a darker green because more green paint is used.
 - b** They are the same because you get **B** if you add one tin of green paint and one tin of white to batch **A**.
 - c** In **A**, for every green tin there are $1\frac{1}{2}$ white tins. In **B**, for every green tin there are $1\frac{1}{3}$ white tins. There is less white in **B** so it's a darker green.
 - d** $\frac{2}{5}$ of batch **A** is green. $\frac{3}{7}$ of batch **B** is green. $\frac{3}{7}$ is greater than $\frac{2}{5}$ so **B** is the darker green.
 - e** To batch **A** add half as much paint again. We then have 3 green and $4\frac{1}{2}$ white. In batch **B** we have 3 green and 4 white so **B** gives a darker green.
 - f** There are 4 white tins in Batch **B** and only 3 in batch **A** so batch **A** gives the darker green.
 - g** If I took 3 lots of batch **A** and 2 lots of batch **B** both lots would have 6 tins of green paint. The 3 lots of batch **A** would have 9 tins of white paint while the 2 lots of batch **B** would have only 8, so batch **B** would give a darker green.



11:03 | Using Ratio to Solve Problems

Outcome NS4.3



'My fish is three times longer than yours.'

Find the length of the bigger fish if the smaller fish is:

- 1 10 cm long 2 30 cm long 3 1 m long.

Find the length of the smaller fish if the bigger fish is:

- 4 30 cm long 5 1.2 m long.

Complete the following:

$$6 \quad \frac{3}{4} = \frac{\square}{20}$$

$$7 \quad \frac{15}{8} = \frac{\square}{24}$$

$$8 \quad \frac{9}{16} = \frac{27}{\square}$$

Solve the equations:

$$9 \quad \frac{x}{8} = \frac{5}{4}$$

$$10 \quad \frac{x}{5} = \frac{4}{3}$$

- We have seen that statements such as 'My fish is three times longer than yours' do not give the actual size of either fish. However, once the length of either fish is known, the length of the other can be calculated.
- In many problems we are told the ratio of two quantities. We are then given one quantity and asked to calculate the other.

worked example 1

A woman mixes sand and cement in the ratio 5 : 2 by volume. If she uses 5 buckets of cement, how much sand should she use?

Solution

Method 1 (the unitary method)

2 buckets of cement to 5 buckets of sand

1 bucket of cement to $\frac{5}{2}$ buckets of sand

5 buckets of cement to $\frac{5}{2} \times 5$ buckets of sand

\therefore 5 buckets of cement needs 12.5 buckets of sand.



$$\begin{aligned} & \text{■} \quad 2 : 5 \\ &= 2 \text{ parts} : 5 \text{ parts} \\ &= 1 \text{ part} : \frac{5}{2} \text{ parts} \\ &= 5 \text{ parts} : \frac{25}{2} \text{ parts} \end{aligned}$$



Method 2 (the ratio method)

Let the number of buckets of sand be x .

$$\begin{aligned} \therefore \frac{\text{buckets of sand}}{\text{buckets of cement}} &= \frac{5}{2} \\ \therefore \frac{x}{5} &= \frac{5}{2} \\ x &= \frac{5}{2} \times 5 \\ &= 12.5 \end{aligned}$$

\therefore She needs 12.5 buckets of sand.

worked example 2

Two business partners, Jim and Larry, decide to divide the profits from a business venture in the same ratio as their investments. If Jim invests \$9000 and Larry invests \$5000, how much should Larry receive if Jim receives \$3600?

Solution

Method 1

Jim's share : Larry's share = 9 : 5
 9 shares earn \$3600
 1 share earns $\$3600 \div 9 = \400
 5 shares earn $\$400 \times 5 = \2000
 \therefore Larry's share = \$2000.

Method 2

Let Larry's share be \$x.

$$\begin{aligned}\therefore \frac{\text{Larry's share}}{\text{Jim's share}} &= \frac{5}{9} \\ \therefore \frac{x}{3600} &= \frac{5}{9} \\ x &= \frac{5}{9} \times 3600 \\ &= \$2000 \\ \therefore \text{Larry receives } \$2000.\end{aligned}$$

Use Method 2 whenever you can. Write the ratios as fractions.



Exercise 11:03

Foundation Worksheet 11:03

Ratio problems NS4-3

- 1 Simplify each ratio.
 a 4 : 2 b 20 : 30
- 2 A map has a scale of 1 : 1000. Two places are 1 cm apart on the map. What is the distance between these places?

1 Solve the following equations.

- | | |
|---|---|
| <p>a $\frac{x}{5} = \frac{7}{4}$</p> <p>c $\frac{x}{5} = \frac{5}{8}$</p> <p>e $y : 4 = 7 : 2$</p> <p>g $3 : 2 = 7 : a$</p> | <p>b $\frac{x}{3} = \frac{7}{2}$</p> <p>d $\frac{x}{4} = \frac{5 \cdot 6}{3}$</p> <p>f $m : 10 = 4 : 12$</p> <p>h $3 : b = 4 : 5$</p> |
|---|---|

- 2 a The ratio of boys to girls in the room is 2 : 1. If there are 8 girls, how many boys are there?

- b Alan and Rachel share some money in the ratio 5 : 3. If Rachel receives \$204, how much does Alan receive?

- c The ratio of children to adults on a bushwalk is 10 : 3. If there are 12 adults, how many children are there?

- d Liam and Bronte divided some money in the ratio 2 : 3. If Liam has \$5.40, how much does Bronte have? How much money was divided?

- e A mortar mix is made up of sand and cement in the ratio 4 : 1. If 12 parts of sand are used, how many parts of cement are needed?

- f A two-stroke petrol mixture is made by mixing petrol and oil in the ratio of 25 : 1. How many litres of petrol need to be added to 200 mL of oil to make this mixture?

$$\frac{\text{no. of boys}}{\text{no. of girls}} = \frac{2}{1}$$

$$\frac{\text{Alan's share}}{\text{Rachel's share}} = \frac{5}{3}$$

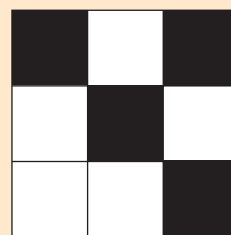
- 3** a The ratio of a boy's mass to that of his father is $\frac{3}{8}$. If the boy weighs 27 kg, what does his father weigh?
- b A type of solder is made by mixing lead and tin in the ratio of 2 : 3.
- How much lead would need to be mixed with 5.4 kg of tin to make the solder?
 - How much tin would need to be mixed with 285 g of lead to make the solder?
- c A model aeroplane is built to a scale of 1 : 80. If the wingspan of the model is 85 cm, what is the wingspan of the aeroplane?
- d A kindergarten works on the basis of two teachers for every 19 children. How many teachers would be needed for 38 children?
- e The ratio of the selling price of an item to the cost price is 11 : 10. Find the cost price if the selling price is \$59.51.
- 4** a The scale on a map is 1 : 25 000. What actual distance would be represented by a length of 3.5 cm on the map?
- b A concrete is made by mixing gravel, sand and cement in the ratio of 5 : 4 : 2. How much gravel and sand would be added to 5 parts of cement?
- c An alloy is made by mixing copper, tin and zinc in the ratio of 10 : 12 : 9. If only 28 kg of copper is used, how much tin and zinc is needed to make the alloy?
- d A sum of money was divided among three people in the ratio 8 : 3 : 5. If the smallest share was \$720, what were the other shares and how much money was there to be divided?
- 5** 9-carat gold is a mixture of three parts gold to five parts other metals (to add hardness).
- What is the ratio of gold to other metals?
 - If 24 g of gold is used to make 9-carat gold, how much of the other metal is used?
 - If 60 g of other metals was used, how much gold would be needed?



11:03

Investigation 11:03 | Using ratio

- Square tiles of length 20 cm are arranged in the pattern on the right. This square of nine tiles, some black and some white, is repeated to cover a rectangular floor 6 metres long and 3 metres wide.
 - How many tiles are needed to cover the floor?
 - How many black tiles are needed?
 - How many of each tile needs to be ordered, allowing for 10% breakages?
 - What would be the total cost if each black tile costs \$1.85 and each white tile costs \$2.40?
- Investigate which measurements for rectangular floors would allow this pattern to fit nicely on the floor (with only complete patterns used).
- Investigate the various gears of a 10-speed racing bicycle.



11:04 | Dividing a Quantity in a Given Ratio

Outcome NS4-3

A second type of ratio problem involves dividing or sharing a quantity between a number of people in a given ratio. These types of problems and their solutions are given below.



worked examples

- 1 A school consists of boys and girls in the ratio 4 : 3. If there are 560 students in the school, find how many boys and girls are in the school.
- 2 Two brothers, Cliff and Richard, are to divide \$1890 between them in the ratio 5 : 4. How much does each receive?

Solutions

1 Method 1

There are 560 students.
Ratio of boys: girls = 4 : 3
The total number of parts is 7.
 \therefore Each part = $\frac{560}{7} = 80$
 \therefore Number of boys = 4×80
 $= 320$
 \therefore Number of girls = 3×80
 $= 240$

2 Method 2

\$1890 is to be divided into 9 shares.
Cliff will take 5 shares.
Richard will take 4 shares.
9 shares = \$1890
 \therefore 1 share = \$210 (ie $\frac{\$1890}{9}$)
 \therefore 4 shares = \$840 (ie $\$210 \times 4$)
5 shares = \$1050 (ie $\$210 \times 5$)
 \therefore Cliff receives \$1050 and
Richard receives \$840.

Method 2

There are 560 students.
Ratio of boys: girls = 4 : 3
 \therefore Boys are $\frac{4}{7}$ of total population.
 \therefore Girls are $\frac{3}{7}$ of total population.
 \therefore Number of boys = $\frac{4}{7}$ of 560
 $= 320$
 \therefore Number of girls = $\frac{3}{7}$ of 560
 $= 240$

Method 2

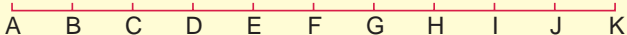
\$1890 is to be shared.
Cliff will take $\frac{5}{9}$ of the money.
Richard will take $\frac{4}{9}$ of the money.
Cliff's share = $\frac{5}{9}$ of \$1890
 $= \$1050$
Richard's share = $\frac{4}{9}$ of \$1890
 $= \$840$
 \therefore Cliff receives \$1050 and
Richard receives \$840.

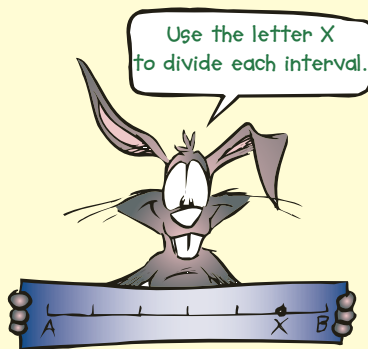
Discussion

Ravi and Jane put their money together to buy a car. Ravi puts in \$3000 and Jane puts in \$5000. Two years later they sell the car for \$5600.

- If only the money invested is considered, how much should each receive from the sale?
- What other information do you think could influence the size of the shares in the car when it is sold? Discuss with others in your class.

Exercise 11:04

- 1** a Divide 16 in the ratio 5 : 3. **b** Divide 200 in the ratio 1 : 4.
c Divide 420 in the ratio 7 : 5. **d** Divide 1510 in the ratio 3 : 2.
e Divide 585 in the ratio 1 : 3 : 5. **f** Divide 41 400 in the ratio 6 : 4 : 5.
- 2** a Pewter is made by mixing tin and lead in the ratio 4 : 1. How much of each metal would there be in 20 kg of pewter?
b In a town the ratio of adults to children is 2 : 5. How many children are there in the town if the population is 8400?
c A tin of two-stroke petrol mixture holds 3.9 L. If the mixture is made from petrol and oil in the ratio 25 : 1, find the amount of oil in the mixture.
d A fruit drink is made by mixing juice and water in the ratio 3 : 1. How much juice would be needed to make 1200 mL of drink?
e A brand of fertiliser is made by mixing nitrates, potash and phosphates in the ratio 2 : 3 : 3. How many kilograms of each are in a 50 kg bag of fertiliser?
f A certain range of bricks is made by mixing three different types of bricks in the ratio 4 : 1 : 3. If 28 000 bricks are needed to build a house, how many of each type will be needed?
g A dry concrete mix is made by mixing gravel, sand and cement in the ratio 6 : 4 : 1 by mass. Find the mass of each required to make 66 kg of the dry cement mix.
h The lengths of the sides of a triangle are in the ratio 1 : 2 : 3. Find the lengths of the sides if the triangle has a perimeter of 42.6 cm.
- 3** a 
 Which point divides the line AK in the ratio:
i 9 : 1? **ii** 7 : 3? **iii** 3 : 7?
iv 4 : 1? **v** 1 : 4?
b Draw a line AB, 12 cm long, and divide it into 6 equal parts. Then find the point that divides the line in the ratio 5 : 1.
c Draw a line 8 cm long and divide it in the ratio 5 : 3.
d Draw a line 6 cm long and divide it in the ratio 1 : 4.
- 4** a A rectangle has a perimeter of 64 cm. If the ratio of its length to its breadth is 5 : 3, find the length of the rectangle.
b The ratio of the populations of town A and town B is 3 : 8, while the ratio of the populations of towns B and C is 5 : 2. If the total population of the three towns is 85 342, find the population of each town.
c A chemical solution is made by mixing an acid with water in the ratio 1 : 24. This solution is then taken and mixed with water in the ratio 1 : 3. How much acid would there be in 200 mL of this final solution?



Fun Spot 11:04 | Multiplication can be fun

Long multiplication sums can be a pain. But have you tried doing them like this?
For a sum like 58×25 , follow the steps given below.

■ Numbers in this column are doubled.

$$\begin{array}{r}
 58 \times 25 \\
 \hline
 116 \\
 232 \\
 \hline
 464 \\
 928 \\
 \hline
 1450
 \end{array}$$

■ Numbers in this column are halved, ignoring any remainder.
• If the number in this column is even, the row is crossed out.

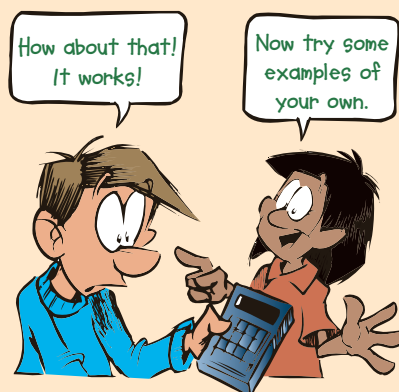
■ To find the answer, add up the remaining numbers in this column.

$58 \times 25 = 1450$

Here's another example for you to follow:

$$\begin{array}{r}
 35 \times 21 \\
 \hline
 70 \\
 140 \\
 \hline
 280 \\
 560 \\
 \hline
 735
 \end{array}$$

$\therefore 35 \times 21 = 735$



Now try some questions of your own. Check your answers with a calculator.

Investigation 11:04 | Ratio research

- 1 Collect information from containers of products that need to be mixed. In each case write the instructions as a ratio.
- 2 Make a list of cases you discovered where different units are used in the same ratio, eg three teabags to one teapot of boiling water.
- 3 Make a list of appliances and machines used for mixing ingredients in a given ratio, eg a cement mixer.
- 4 Discuss your findings with others in the class.



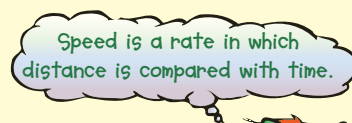
You need to be able to compare quantities that have different units.

- 4 teaspoons of coffee : 2 mugs of water
- 1 cap of detergent : 5 litres of water
- 6 small buttons : 8 large buttons
- 90 kilometres : 2 hours



- As seen above, a **rate** is a comparison of unlike quantities.
- The most commonly used rate is speed which compares *distance travelled to time taken*.
eg $20 \text{ km} : 2 \text{ hours} = 10 \text{ km} : 1 \text{ hour} = 10 \text{ km/h}$

- To make rates easier to work with, we usually change the rate to an equivalent rate where we write down how many of the first quantity correspond to one of the second quantity. Rates can be changed (as with ratios) by multiplying or dividing both quantities by the same number.



$$\begin{aligned} &150 \text{ km in } 2 \text{ h} \\ &= \frac{150}{2} \text{ km in } \frac{2}{2} \text{ h} \\ &= 75 \text{ km in } 1 \text{ h} \\ &= 75 \text{ km/h} \end{aligned}$$



- To simplify rates we can multiply or divide both terms by the same number, just as we do for ratios.
- When using a rate we must show the units.
- Rates are usually expressed by writing down how many of the first quantity correspond to one of the second.
eg $6000 \text{ mL for } 10 \text{ bottles} = 600 \text{ mL per } 1 \text{ bottle}$
 $= 600 \text{ mL/bottle}$



- The solution of rate problems is also similar to the solution of ratio problems. The two basic problems are shown in Worked Examples 2 and 3 on the next page.

worked examples

- 1 Express each of the following as a rate in its simplest form.

- a A woman travels 210 km in 3 hours. b 500 sheep are grazed on 200 hectares.

Solution

- a 210 km in 3 hours
Divide each term by 3.
 $= 70 \text{ km in } 1 \text{ hour}$
 $= 70 \text{ km/h}$

- b 500 sheep on 200 hectares
Divide by 200.
 $= \frac{500}{200} \text{ sheep on } 1 \text{ hectare}$
 $= 2.5 \text{ sheep/hectare}$



- 2 A mine supplies ore at the rate of 1500 tonnes per day.
- How many tonnes can the mine supply in 4 weeks?
 - How long will it take to supply 60 000 tonnes?

Solution

a 1500 t/day

$$= \frac{1500 \times 28 \text{ t}}{1 \times 28 \text{ days}}$$

(since 4 weeks = 28 days)

$$= \frac{42\,000 \text{ t}}{4 \text{ weeks}}$$

\therefore 42 000 t can be supplied in 4 weeks.

OR

$$\begin{aligned} &1500 \text{ t in 1 day} \\ &= 1500 \times 28 \text{ t in 28 days} \\ &= 42\,000 \text{ t in 4 weeks} \end{aligned}$$

b 1500 t/day

$$= \frac{1500 \text{ t} \times 40}{1 \text{ day} \times 40}$$

(since $60\,000 \div 1500 = 40$)

$$= \frac{60\,000 \text{ t}}{40 \text{ days}}$$

60 000 t/40 days

OR

$$\begin{aligned} &1500 \text{ t in 1 day} \\ &= 1 \text{ t in } \frac{1}{1500} \text{ days} \\ &= 60\,000 \text{ t in } 60\,000 \times \frac{1}{1500} \text{ days} \\ &= 60\,000 \text{ t in 40 days} \end{aligned}$$

In worked examples (2) and (3), both types of rate problems are given.



- 3 A shearer sheared 70 sheep in 2 hours. If he could continue at this rate, find:
- how long it would take to shear 200 sheep, to the nearest hour
 - how many sheep could be sheared in 8 hours.

Solution

a 70 sheep in 2 hours

$$= 35 \text{ sheep in 1 hour}$$

$$= 35 \text{ sheep/h}$$

Now 35 sheep in 1 h

$$= 1 \text{ sheep in } \frac{1}{35} \text{ h}$$

$$= 200 \text{ sheep in } 200 \times \frac{1}{35} \text{ h}$$

$$= 200 \text{ sheep in } 5\frac{5}{7} \text{ h}$$

\therefore 200 sheep would take 6 h to shear, to the nearest hour.

b 35 sheep in 1 hour

$$= 35 \times 8 \text{ sheep in 8 hours}$$

$$= 260 \text{ sheep in 8 hours}$$

\therefore 260 sheep could be sheared in 8 hours.



Notice:

One type of rate problem is solved using multiplication. The other uses division.

Exercise 11:05

Foundation Worksheet 11:05

Rates NS4-3

1 Simplify each rate.

a \$80 for 8 b 20 km/2 h

2 a I can buy 10 apples for \$2.
How many apples can I buy for \$5?

1 Write each of the following as a rate in simplest form.

a 8 km in 2 h

b 10 kg for \$5

c 5 km in 20 min

d 120 L in 4 h

e 500c for 20 g

f \$315 for 7 days

g 120 children for 4 teachers

h 20 degrees in 5 min

i 60 sheep in 3 hours

j 40 kg over 8 m²

l 60 km in 1½ h

m 150 L in 1½ h

k 70 g for 10 cm³

n 18 min for 4.5 km

2 Complete the equivalent rates.

a 2 km/min = ... km/h

b 4 kg/min = ... kg/h

c 0.02 kg/m² = ... kg/ha

d 5 L/h = ... L/day

e \$5/g = \$.../kg

f 5 mL/min = ... mL/h

g 4 km/h = ... m/h

h 2 L/h = ... mL/h

i 1.2 t/d = ... kg/d

j 20c/min = \$.../min

k \$2.45/kg = ... c/kg

l 15 mL/min = ... L/min

m 3 m/s = ... km/h

n 25 mL/s = ... L/h

o 15 t/h = ... t/day

p 20 g/m² = ... kg/ha

q 10 km/L = ... m/mL

r 7 g/cm³ = ... t/m³

3 a I walk at 5 km/h. How far can I walk in 3 hours?

b How far will a car travelling at 80 km/h travel in 2½ hours?

c A jet plane is travelling at 600 km/h. How far will it travel in 25 minutes?

d A girl cycled at 18 km/h for 4½ h. How far did she cycle?

e How long will it take to travel 200 km at 80 km/h?

f How long should it take to run 14 km at an average speed of 4 min/km?

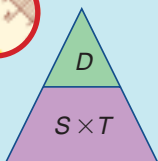
g A train travels 960 km at an average speed of 80 km/h. How long will the trip take?

h How long will it take a spacecraft travelling at 1700 km/h to travel 238 000 km?

i A train left town A at 9 am and arrived at town B at 4 pm. What was its average speed if it travelled 665 km?

j A rocketship takes 1½ hours to make an orbit of the Earth. If one orbit is 30 000 km, what is its speed? How far would it travel in 10 minutes at this speed?

k A woman runs the marathon in 2 hours 25 minutes. If she covers 42.2 km, calculate her average speed.



D = distance, S = speed, T = time

If you cover the quantity you are trying to calculate, this triangle will tell you what to do.

So:

$$D = S \times T \quad S = \frac{D}{T} \quad T = \frac{D}{S}$$

Thomas's triangle will sort out your speed problems!



4 a Nails cost \$4.60 per kg. What is the cost of 20 kg?

b A cricket team scored at an average of 5 runs/over. How many runs did they score off 17 overs?

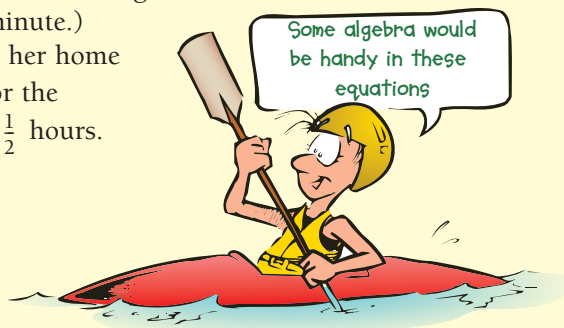
c A shearer could shear 15 sheep/hour. How many sheep could he shear in 8 hours?

d The density of iron is 7.5 g/cm³. What is the mass of 500 cm³?

e A heart is beating at 90 beats/min. How many beats will it make in 1 hour?

f Perfume costs \$12 for 100 mL. How much would 1 L cost?

- g A mine supplies 1200 t of ore per hour. How much would it supply in 1 week?
- h If \$1 Australian = US\$0.719, what is the value in US dollars of \$500 Australian?
- i Fertiliser is spread at a rate of 1 kg/40 m². What area can be covered by 25 kg?
- j Water is dripping from a tap at a rate of 5 L/h. How much water will leak in 1 day?
- 5** a Nails cost \$4.60/kg. How many kilograms can be bought for \$20?
- b If I can save \$40/week, how long should it take to save \$1000?
- c A bulldozer is moving soil at the rate of 15 t/h. How long will it take to move 400 t?
- d A tank that holds 1000 L is leaking at a rate of 2.5 L/min. How long will it take to lose 400 L at this rate?
- e Blue metal is moved at a rate of 22 t/truck. How many trucks would be needed to move 480 t of metal?
- f A car uses petrol at the rate of 9.5 L/100 km. How many litres would be used in travelling 350 km?
- g A machine fills bottles at the rate of 120 bottles/min. How long would it take to fill 1000 bottles at this rate?
- h Fertiliser is to be spread at a rate of 20 kg/ha. How many hectares can be covered by 50 kg?
- i If it takes 25 tiles to cover 1 m², how many square metres will be covered by 175 tiles?
- j Runs were scored at a rate of 5 runs/over in a cricket match. How many overs did it take to score 90 runs?
- 6** a Light travels at 300 000 km/s.
- i How far does it travel in 1 minute?
- ii How long would it take light to travel from the sun, which is 148 800 000 km away?
- b The density of iron is 7.5 g/cm³. Find the mass in kilograms of a rectangular block of iron 100 cm long, 100 cm wide and 2 cm thick.
- c The fastest man in the world can run 100 m in 10 s. If he could continue at this rate, what would his speed be in kilometres per hour?
- d A racing car travels at a speed of 180 km/h. How long would it take to travel 100 m?
- e Land rates are paid at 4.95 cents per dollar of the land's value.
- i How much will the rates be for land with a value of \$15 000?
- ii What would be the value of land for which the rates are \$544.50?
- 7** a Pump A can fill a tank in 5 minutes while pump B can fill a tank in 10 minutes. How long will it take to fill the tank if both are working together?
- b In making one revolution, a car wheel travels 200 cm. How fast are the wheels spinning, in revolutions per minute, when the car is travelling at 60 km/h? (Answer to the nearest revolution per minute.)
- c A girl paddles her kayak upstream from her home to her friend's home, taking $2\frac{1}{2}$ hours for the journey. She returns that afternoon in $1\frac{1}{2}$ hours. If the river is flowing at $2\frac{1}{2}$ km/h, find:
- i her paddling speed in still water
- ii the distance to her friend's place.





Complete the following:

1 $1 \text{ m} = \dots \text{ cm}$

2 $1 \text{ cm} = \dots \text{ mm}$

3 $1 \text{ m} = \dots \text{ mm}$

Convert:

4 2000 cm to m

5 $250\,000 \text{ mm}$ to m

Simplify the ratios:

6 $1 \text{ cm} : 1 \text{ m}$

7 $1 \text{ mm} : 1 \text{ m}$

Complete the following:

8 $1 : 100 = 5 : \square$

9 $1 : 1000 = 6 : 8 : \square$

10 $1 \text{ cm} : 1 \text{ m} = 5 \text{ cm} : \square$



Scale drawings are used often in everyday life. People such as architects and engineers make scale drawings of buildings and bridges, and people such as builders must be able to read them so that these things can be built.

- Scale drawings have the same shapes as the objects that they represent but they are of different sizes.
- The scale of a drawing = length on drawing : real length.
So a scale of $1 : 100$ means that the real length is 100 times the length on the drawing.
- The scale determines the size of the drawing. The closer the size of terms in the scale ratio, the closer the drawing is to real size. So a $1 : 10$ scale drawing would be bigger than a $1 : 100$ scale drawing of the same object.



In scale drawing work there are only two types of problems.

- The first type involves making a scale drawing of an object.
- The second type involves calculating the real sizes of objects from the drawing.



A scale drawing of an object is the same shape as the object but a different size.

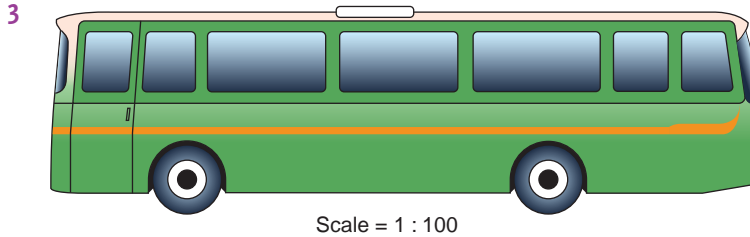
$$\text{Scale} = \text{length on drawing} : \text{real length}$$

A scale can be written in two ways, as $1 \text{ cm} : 1 \text{ m}$ OR $1 : 100$.

- If the scale drawing is larger than the real length, then the scale drawing is called an **enlargement** and the first term of the scale would be the larger, eg $5 : 1$.

worked examples

- 1 Simplify these scales: **a** 1 mm : 1 m **b** 1 cm : 2 m **c** 5 mm : 1 km
- 2 **a** The scale on a drawing is 1 : 100. What is the real distance between two points that are 5 cm apart on the drawing?
- b** Two trees are 50 m apart. How far apart would they be on a drawing with a scale of 1 : 500?



From the drawing, by measurement and calculation, find:

- a** the maximum length of the bus
- b** the maximum height of the bus.

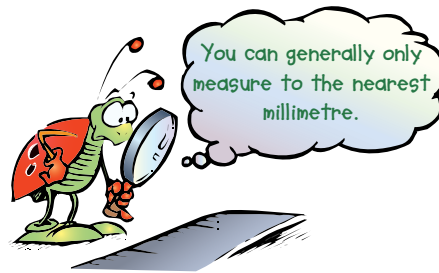
Solutions

- 1 **a** 1 mm : 1 m
= 1 mm : 1000 mm
= 1 : 1000
- b** 1 cm : 2 m
= 1 cm : 200 cm
= 1 : 200
- c** 5 mm : 1 km
= 5 mm : 1000 m
= 5 mm : 1 000 000 mm
= 1 : 200 : 000

- 2 **a** Scale = 1 : 100
 $\therefore \frac{1}{100} = \frac{5 \text{ cm}}{\text{real distance}}$
 $\therefore \text{real distance} = 5 \times 100 \text{ cm}$
= 500 cm
= 5 m

- b** Scale = 1 : 500
 $\therefore \frac{1}{500} = \frac{\text{dist. on drawing}}{50 \text{ m}}$
 $\therefore 500 \times \text{dist. on drawing} = 50 \text{ m}$
distance on drawing = $\frac{50 \text{ m}}{500}$
= $\frac{1}{10} \text{ m}$
= 10 cm

- 3 **a** Length of drawing = 93 mm
 $\therefore \text{Real length} = 100 \times 9.3 \text{ cm}$
= 930 cm
= 9.3 m
- b** Height on drawing = 27 mm
 $\therefore \text{Real height} = 100 \times 2.7 \text{ cm}$
= 270 cm
= 2.7 m



■ The accuracy of answers in scale drawing work is determined by the scale and the limitations of our measuring instruments.

Exercise 11:06

- 1 Copy and complete each of the following.

a $1:100 = 1\text{ cm} : \dots$

b $1:1000 = 1\text{ cm} : \dots$

c $1:1000 = 1\text{ m} : \dots$

- 2 Write each of the following scales in ratio form.

a 1 cm to 1 m

b 1 cm to 10 m

c 1 mm to 10 m

d 1 mm to 5 m

e 2 cm to 1 m

f 5 mm to 1 m

g 5 cm to 1 m

h 5 cm : 1 km

- 3 Calculate the real distance between points which are the following distances apart on a map if the scale on the map is $1:1000$.

a 5 cm

b 3.5 cm

c 10.6 cm

d 8.1 cm

e 1 mm

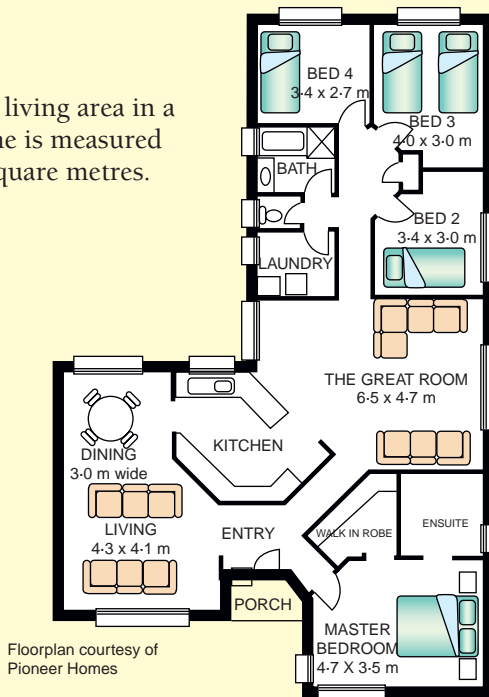
f 8 mm

g 26 mm

h 0.5 mm

4

The living area in a home is measured in square metres.



The scale used in this house plan is $1:200$.

- What real distance is represented by 1 cm?
- Find the real length of:
 - the bathroom
 - bedroom 3
 - the house
 - the inner kitchen wall
- Find the real area of bedroom 3.
- Find the inside area of the house to the nearest square metre.
- Find the area of the great room.
- How much would it cost to tile the floor of the great room at \$38.50 per square metre.

- 5 The scale on a drawing is 1 cm to 5 m. Calculate the real distance between two points if they are the following distances apart on the drawing:

a 2 cm

b 5 cm

c 6.4 cm

d 4.2 cm

e 1 mm

f 42 mm

g 27 mm

h 59 mm

- 6 A scale drawing is to be made using a scale of $1:100$. What lengths would the following real distances be represented by on the drawing?

a 100 cm

b 300 cm

c 750 cm

d 4.3 m

e 63 m

f 42 m

g 15.6 m

h 2.4 m

If the scale is $1:b$, multiply by b to find the real distance, or divide by b to find the scaled distance.



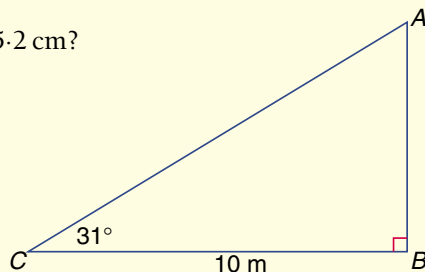
- 7** The distances between pairs of points in real life are measured. How far apart will each of these be on a scale drawing with a scale of 1 cm : 20 m?

a 40 m **b** 60 m **c** 200 m **d** 30 m
e 8 m **f** 25 m **g** 11 m **h** 315 m

- 8** **a** The plan of a house is drawn to a scale of 1 : 100. If a room measures 36 mm by 42 mm on the plan, how big is the room in real life?
b A model aeroplane is built to a scale of 1 : 72. What would the real wingspan be if the wingspan of the model is 30 cm?
c A map has a scale of 1 : 250 000. What real distance would be represented by a scaled distance of:

i 1 mm? **ii** 35 mm? **iii** 1 cm? **iv** 5.2 cm?

- d** A girl made this scale drawing to calculate the height, AB , of a triangular wall.
i Measure the distance CB on the scale drawing and calculate the scale of the drawing.
ii By measurement and calculation, find the height AB .
iii Find the area of this triangular wall.



- 9** **a** An oval is 85 m long and 58 m wide. What would these lengths be on a scale drawing if the scale was:

i 1 cm : 10 m? **ii** 1 cm : 5 m? **iii** 1 : 200?

- b** A house fits inside a rectangle 23 300 mm long and 12 200 mm wide. What is the smallest size of paper on which a scale drawing could be made if the scale is 1 : 100?
c A 1 : 50 scale model of a yacht is to be built. If the yacht is 25 m long, how long will the model yacht be?
d A scale drawing is to be made of a car. If the car is 6.25 m long and the model is to be 25 cm long, what should the scale be?
e A kitchen design company is asked to design a kitchen for a new house. The dimensions of the kitchen are 5200 mm by 3800 mm. What would the scaled size of the kitchen be if the scale is 1 : 100? Calculate the scaled size of the refrigerator (real size 600 mm by 600 mm) and the sink (real size 1200 mm by 500 mm).

- 10** Use the scale on the map to find the distance by road from:

- a** Geelong to Cressy
b Portsea to Queenscliff
c Lilydale to Colac
d Rokewood to Pakenham

Further work on scale drawing can be found in 16:01 and 16:02.

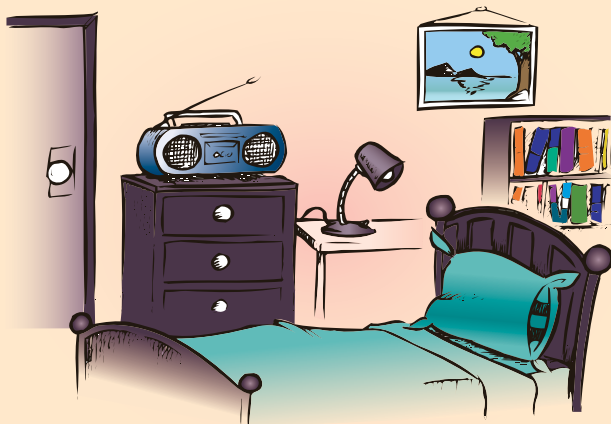




11:06

Investigation 11:06 | Scale my room!

- Make a scale drawing of a room in your house.
- Calculate the scaled sizes of the furniture in the room and mark the position of each piece on the drawing.
- Make paper cut-outs to represent the furniture.
- Use paper cut-outs to rearrange the furniture in the room.
Can you find a better arrangement?



11:06

Challenge 11:06 | Cutting rectangles

24 cm

16 cm

• Start with a rectangle 24 cm long and 16 cm wide. Write down the ratio length : width. Here it is 24 : 16, or 3 : 2.

• Cut the rectangle in half as shown and continue to do this again and again, each time recording the ratio length : width in its simplest form.

• What pattern did you discover? (Explain this in full sentences.)

• Investigate what happens when you start with a rectangle that has:

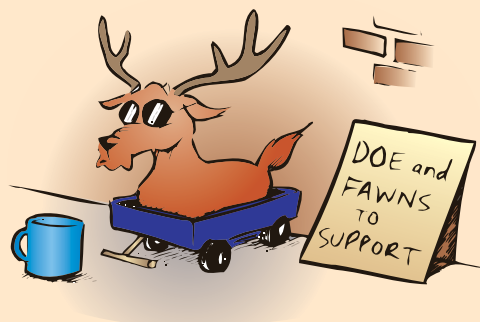
- a length 16 cm, width 16 cm
- b length 24 cm, width 8 cm.



11:06

Fun Spot 11:06 | What do you call a deer with no eyes?

Work out the answer to each part and put the letter for that part in the box above the correct answer.



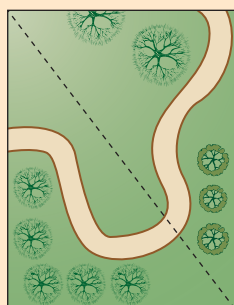
- E Simplify the ratio $12 : 8$.
- I Find x if $12 : 8 = x : 40$.
- A Find m if $\frac{m}{3} = \frac{20}{6}$.
- O Simplify the rate 18 L in 6 m^2 .

Find the value of y if:

- N $12 \text{ L/s} = y \text{ L/min}$
- D $0.6 \text{ kg/h} = y \text{ g/h}$

720	3 L/m^2	60	600	$3 : 2$	10

What do you call a deer with no eyes and no legs?



This rectangle is a scale drawing of a garden. Find the ratio of:

- L length : breadth
- A length : diagonal
- D diagonal : breadth
- O How many metres long is the garden?
- L What is the scale used in this drawing?
- I What is the area of the scale drawing?
- T What is the area of the garden?
- I What is the ratio of the area of the scale drawing to the area of the garden?

150 newspapers are divided in the ratio $7 : 3$.

- S How many newspapers are in the smaller share?
- N How many newspapers are in the larger share?
- E What fraction of the newspapers is the smaller share?

45	1200 m^2	12 cm^2	$4 : 3$	$1 : 10^3$	105	40	$1 : 10^6$	$5 : 3$	$\frac{3}{10}$	$4 : 5$



- Estimate the ratio of:
 - a red lollies : green lollies
 - b red lollies : green lollies : black lollies



11

Maths terms 11

rate

- A comparison of unlike quantities written in a definite order.
eg 20 km in 5 h or 20 km/h
- Units are used in this comparison.
eg 8 people per car

ratio

- A comparison of like quantities or numbers written in a definite order.
- Equivalent ratio** (an equal ratio). This is formed when the terms of a ratio are multiplied or divided by the same number.

scale

- The ratio of the length that a drawing has to the original length.
- If a map has a scale of 1 : 10 000, then 1 cm on the map represents 10 000 cm (ie 100m) in real terms.

scale drawing

- A scale drawing has the same shape as the object it represents but a different size.
- The scale of a drawing
= length on drawing : real length.



Maths terms 11



11

Diagnostic Test 11: | Ratio, Rates and Scale Drawing

- Each section of the test has similar items that test a certain type of question.
- Errors made will indicate areas of weakness.
- Each weakness should be treated by going back to the section listed.

These questions can be used to assess part of outcome NS4.3.

	Section
<p>1 Concrete is made by mixing 1 part cement with 2 parts sand and 4 parts gravel. Write down the ratio of:</p> <p>a cement to sand b cement to gravel</p> <p>c cement to sand to gravel d gravel to cement to sand</p>	11:01
<p>2 Simplify the ratios:</p> <p>a 10:4 b 16:4 c 1.5:6 d $1\frac{1}{2}:2\frac{1}{4}$</p>	11:02
<p>3 Complete the following:</p> <p>a $5:2 = 10:\square$ b $1:3 = 6:\square$</p> <p>c $4:3 = \square:18$ d $2:5 = \square:20$</p>	11:03

4 Solve the following:

a $\frac{x}{3} = \frac{5}{8}$ b $\frac{x}{5} = \frac{10}{3}$ c $\frac{x}{4} = \frac{1.8}{5}$ d $\frac{2.5}{6} = \frac{x}{4}$

11:03

5 a The ratio of boys to girls is 6 : 5. If there are 15 girls, how many boys are there?

11:03

b Sand and cement are mixed in the ratio 7 : 2. If 3 kg of cement are used, how much sand is used?

c Liam and Bronte share money in the ratio 2 : 3. If Liam's share is \$1.80, what is Bronte's share?

d An alloy is made by mixing metals A, B and C in the ratio 2 : 5 : 3. If 9 kg of C are used, how much of B is used?

6 a Divide 15 in the ratio 3 : 2.

b Divide 45 in the ratio 2 : 7.

11:04

c Divide 420 in the ratio 11 : 10.

d Divide 120 in the ratio 1 : 2 : 7.

7 Simplify the rates:

11:05

a 50 km in 2 hours

b 600 t in 4 hours

c 100 g for 8 cm³

d 4 kg over 10 m²

8 Complete the following:

11:05

a 1 m/s = ... m/h

b 200 kg/h = ... t/day

c \$15/g = \$... /kg

d 6 L / h = ... mL/min

11:05

9 a Ore is supplied at a rate of 200 t/day. How much is supplied in 2 weeks?

b A car travels at a speed of 100 km/h. How far will it travel in 3 $\frac{1}{2}$ h?

c Water is pumped at a rate of 100 L/h. How long will it take to pump 550 L?

d A car uses petrol at a rate of 9.6 km/L. How many litres will it use to travel 200 km?

10 A drawing has a scale 1 : 100. Convert the following scaled distances to real distances.

11:06

a 3 cm

b 5.2 cm

c 1 mm

d 42 mm

11 Repeat Question 10 using a scale of 1 cm : 5 m.

11:06

12 A drawing has a scale of 1 : 100. Convert the following real distances to scaled distances.

11:06

a 5 m

b 43 m

c 75 cm

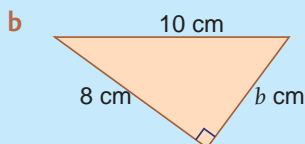
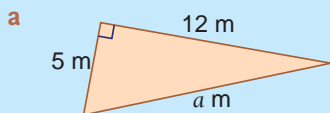
d 4.8 m

13 Repeat Question 12 using a scale of 1 cm : 2 m.

11:06

Chapter 11 | Revision Assignment

- 1 Use Pythagoras' Theorem to find the value of each pronumeral.



- 2 Simplify:

a $6m + 3n + 8 + 2n$

b $4(3a + 1) + 6(3 - a)$

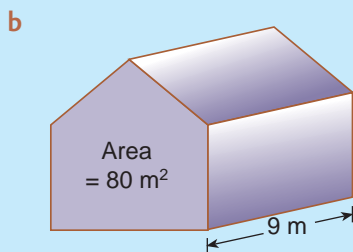
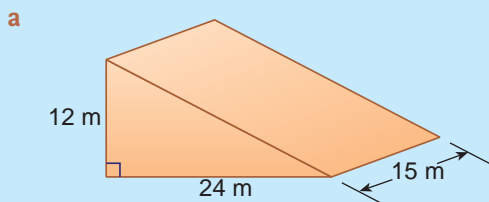
c $\frac{6a + 6b}{6}$

- 3 Which of each set has the smallest value?

a $\{0.75, 1.125\%, \frac{1}{4}\}$

b $\{99.1\%, \frac{5}{2}, 1\frac{1}{4}\}$

- 4 Find the volume of each prism.



- 5 a How much will I pay for a coat costing \$120 at a 10% discount sale?
b I invest \$1000 at an interest rate of $12\frac{1}{2}\%$ p.a. How much interest will I earn in 18 months?

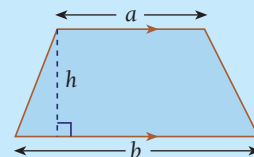
- 6 If $M = \frac{A}{A-5}$, evaluate M when:

a $A = 25$

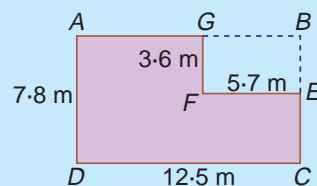
b $A = 7.5$

- 7 The formula for the area of a trapezium is $A = \frac{1}{2}h(a+b)$.

Find A when $h = 3.6$, $a = 2.4$ and $b = 6.8$.



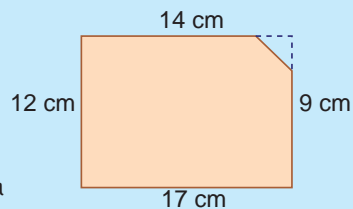
- 8 a Find the area of the rectangle ABCD.



- b Find the area of the rectangle GBEF.

- c Use your answers from parts a and b to find the area of the coloured figure.

- 9 Use the method in Question 8, or another method, to find the area of the coloured figure.



- 10 Solve the equations:

a $5a = 16$

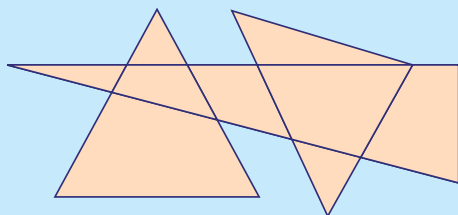
b $\frac{3m}{4} = 5$

c $p - 6 = 2p + 4$

Chapter 11 | Working Mathematically

- 1 Use ID Card 5 on page xviii to identify figure:
a 2 **b** 3 **c** 4 **d** 5
e 8 **f** 16 **g** 17
- 2 Find two numbers that have a sum of 12 and a product of 35.
- 3 All 10 girls in 8B3 play tennis or hockey. Some play both sports. If 8 of the girls play tennis and 8 of the girls play hockey, how many play both sports?
- 4 If it's true that 'all dogs bark', and that 'Nero is a dog', which of the following must be true?
a Nero does not bark.
b Nero is not a dog.
c Nero barks.
d All dogs are called Nero.

5



How many triangles are there in this figure? (Be careful, some may be hidden.)



- 1 Simplifying ratios
- 2 Equivalent ratios
- 3 Rates

- Each domino can use numbers from zero to six on each part and no two dominoes are alike. How many dominoes are in a set?

